

Claims

What is claimed is:

1. A mask inspection method, comprising:

providing a mask fabrication database describing geometrical shapes S to be printed as part of a mask pattern on a reticle to fabricate a mask through use of a mask fabrication tooling, said geometrical shapes S appearing on the mask pattern as geometrical shapes S' upon being printed by the mask fabrication tooling in accordance with the mask fabrication database, at least one of said geometrical shapes S' being geometrically distorted relative to a corresponding at least one of said geometrical shapes S due to a lack of precision in the mask fabrication tooling; and

providing a mask inspection database to be used for inspecting the mask after the mask has been fabricated by the mask fabrication tooling using the mask fabrication database, said mask inspection database describing geometrical shapes S'' approximating said geometrical shapes S', a geometric distortion between said geometrical shapes S' and said geometrical shapes S'' being less than a corresponding geometric distortion between said geometrical shapes S' and said geometrical shapes S.

1 2. The method of claim 1, wherein using the mask inspection database for inspecting the
2 fabricated mask results in a lower inspection failure rate than using the mask fabrication database
3 for inspecting the fabricated mask.

1 3. The method of claim 1, further comprising:
2 fabricating the mask via the mask fabrication tooling using the mask fabrication database;
3 and
4 inspecting the fabricated mask using the mask inspection database.

1 4. The method of claim 3, wherein providing the mask fabrication database includes providing
2 the mask fabrication database to a mask fabrication vendor, wherein providing the mask
3 inspection database includes providing the mask inspection database to the mask fabrication
4 vendor, wherein printing the mask includes printing the mask by the mask fabrication vendor,
5 and wherein inspecting the fabricated mask includes inspecting the fabricated mask by the mask
6 fabrication vendor.

1 5. The method of claim 1, wherein providing the mask inspection database comprises generating
2 S" from S by applying a calibration transformation to S.

1 6. The method of claim 5, further comprising:
2 providing a calibration dataset relating to the mask fabrication tooling; and

3 deriving the calibration transformation from the calibration .

1 7. The method of claim 6, wherein said deriving includes deriving the calibration transformation
2 from the calibration dataset by performing a statistical regression on the calibration.

1 8. The method of claim 6, wherein providing the calibration dataset includes generating the
2 calibration dataset by performing the steps of:

3 providing a plurality of generic geometrical shapes;

4 printing said generic geometrical shapes on a reticle test mask;

5 measuring said printed generic geometrical shapes; and

6 collecting the provided generic geometrical shapes and the measured printed generic
7 geometrical shapes to form the calibration .

1 9. The method of claim 8, wherein the plurality of generic geometrical shapes does not comprise,
2 and is not comprised by, an integrated circuit design.

1 10. The method of claim 5, wherein the geometrical shapes S includes a geometric shape S_1 ,
2 wherein the calibration transformation transforms S_1 to a geometric shape S_1'' of the geometrical
3 shapes S'' , and wherein a first dimension of S_1'' in a direction X differs from a corresponding first
4 dimension of S_1 in the direction X by a first amount that is a first function of at least one
5 geometrical characteristic of S_1 .

1 11. The method of claim 10, wherein the at least one geometrical characteristic of S_1 includes a
2 second dimension of S_1 in a direction Y that is orthogonal to the direction X.

1 12. The method of claim 11, wherein the at least one geometrical characteristic of S_1 further
2 includes the corresponding first dimension of S_1 in the direction X.

1 13. The method of claim 10, wherein the at least one geometrical characteristic of S_1 includes
2 the corresponding first dimension of S_1 in the direction X.

1 14. The method of claim 10, wherein the at least one geometrical characteristic of S_1 includes a
2 distance from S_1 to at least one neighbor of S_1 , said at least one neighbor of S_1 being a geometric
3 shape comprised by the geometrical shapes S.

1 15. The method of claim 10, wherein a second dimension of S_1 in a direction Y that is
2 orthogonal to X differs from a corresponding second dimension of S_1 in the direction Y by a
3 second amount that is a second function of one or more geometrical characteristics of S_1 .

1 16. A mask inspection system, comprising:

2 means for providing a mask fabrication database describing geometrical shapes S to be
3 printed as part of a mask pattern on a reticle to fabricate a mask through use of a mask fabrication
4 tooling, said geometrical shapes S appearing on the mask as geometrical shapes S' upon being
5 printed by the mask fabrication tooling in accordance with the mask fabrication database, at least
6 one of said geometrical shapes S' being geometrically distorted relative to a corresponding at
7 least one of said geometrical shapes S due to a lack of precision in the mask fabrication tooling;
8 and

9 means for generating a mask inspection database to be used for inspecting the mask after
10 the mask has been fabricated by the mask fabrication tooling using the mask fabrication database,
11 said mask inspection database describing geometrical shapes S'' approximating said geometrical
12 shapes S', a geometric distortion between said geometrical shapes S' and said geometrical shapes
13 S'' being less than a corresponding geometric distortion between said geometrical shapes S' and
14 said geometrical shapes S.

1 17. The system of claim 16, wherein using the mask inspection database for inspecting the
2 fabricated mask results in a lower inspection failure rate than using the mask fabrication database
3 for inspecting the fabricated mask.

1 18. The system of claim 16, further comprising:

2 means for fabricating the mask via the mask fabrication tooling using the mask
3 fabrication database; and
4 means for inspecting the fabricated mask using the mask inspection database.

1 19. The system of claim 16, wherein said means for generating comprises means for applying a
2 calibration transformation to S.

1 20. The system of claim 19, further comprising means for deriving the calibration transformation
2 from a calibration dataset relating to the mask fabrication tooling.

1 21. The system of claim 19, further comprising:
2 means for providing a plurality of generic geometrical shapes;
3 means for printing said generic geometrical shapes on a reticle test mask;
4 means for measuring said printed generic geometrical shapes;
5 means for collecting the provided generic geometrical shapes and the measured printed
6 generic geometrical shapes to form a calibration ; and
7 means for deriving the calibration transformation from the calibration .

1 22. The system of claim 21, wherein the plurality of generic geometrical shapes does not
2 comprise, and is not comprised by, an integrated circuit design.

1 23. The system of claim 19, wherein the geometrical shapes S includes a geometric shape S_1 ,
2 wherein the calibration transformation transforms S_1 to a geometric shape S_1'' of the geometrical
3 shapes S'', and wherein a first dimension of S_1'' in a direction X differs from a corresponding first
4 dimension of S_1 in the direction X by a first amount that is a first function of at least one
5 geometrical characteristic of S_1 .

1 24. The system of claim 23, wherein the at least one geometrical characteristic of S_1 includes a
2 second dimension of S_1 in a direction Y that is orthogonal to the direction X.

1 25. The system of claim 24, wherein the at least one geometrical characteristic of S_1 further
2 includes the corresponding first dimension of S_1 in the direction X.

1 26. The system of claim 23, wherein the at least one geometrical characteristic of S_1 includes the
2 corresponding first dimension of S_1 in the direction X.

1 27. The system of claim 23, wherein the at least one geometrical characteristic of S_1 includes a
2 distance from S_1 to at least one neighbor of S_1 , said at least one neighbor of S_1 being a geometric
3 shape comprised by the geometrical shapes S.

- 1 28. The system of claim 23, wherein a second dimension of S_1 in a direction Y that is
2 orthogonal to X differs from a corresponding second dimension of S_1 in the direction Y by a
3 second amount that is a second function of one or more geometrical characteristics of S_1 .